Geotropism.—RITTER[3] applies the rotation method of PICCARD[4] for determining the distribution of geotropic sensitiveness in various grass seedlings. RITTER states that it is through the application of this brilliant conception alone that the distribution of geotropic sensitiveness has been settled in some cases.[5] In *Avena sativa*, *Hordeum vulgare*, and *Phalaris canariensis*, a short tip zone of the coleoptile is very much more sensitive than the basal region, which shows some geotropic sensitiveness. In *Avena* the very sensitive zone is 3 mm. long, and in *Hordeum* and *Phalaris* 4–5 mm. In *Setaria italica* all regions of the coleoptile are equally sensitive, while in *Sorghum vulgare* the tip region shows slightly greater sensitiveness. Since the main curving is in the epicotyl, a conduction of the stimulus to that region from the coleoptile must occur. The distribution of the motile starch in all these organs corresponds closely with the distribution of geotropic sensitiveness, so that RITTER considers the work confirmatory of, or at least not antagonistic to, the statolith starch theory.

In a study of the geotropism of rhizoids carried out in HABERLANDT'S laboratory, BISCHOFF[6] comes to the following conclusions: The rhizoids of the growing gemmae of *Marchantia polymorpha* and *Lunularia cruciata* are, contrary to the conclusion of WEINERT, positively geotropic, and those of the thalli show the same character with lower sensitiveness. BISCHOFF asserts that the lack of motile starch in these rhizoids does not necessarily argue against the statolith theory, for other motile bodies may take its place. The rhizoids of ferns are ageotropic. The main rhizoid of mosses (*Bryum capillare*, *B. argenteum*, and *Leptobryum pyriforme*) is positively geotropic in light, while the protonemata and side rhizoids are ageotropic. In the mosses statolith starch is found in the main rhizoid.

JOST and STOPPEL[7] have established the interesting fact that under high centrifugal force of sufficient duration the roots of *Lupinus* give the negative geotropic response instead of the positive. For negative response 16 gravities or more are needed for decapitated roots, and 70 gravities or more for intact ones. This lines geotropic response up with OLTMANN'S findings for heliotropic response; one and the same organ responds either positively or negatively, depending upon the strength of the stimulus. Parallel with heliotropism a

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[3] RITTER, HERMAN VON GUTTENBERG, Über die Verteilung der geotropischen Empfindlichkeit in der Koleoptile von Gramineen. Jahrb. Wiss. Bot. **50:** 289–327. *fig. 1.* 1912.

[4] PFEFFER, W., Physiology. English ed. **3:** 418–419. 1905.

[5] See review of DARWIN in BOT. GAZ. **46:** 387. 1908; also review of HABERLANDT in BOT. GAZ. **47:** 482–483. 1909.

[6] BISCHOFF, HANS, Untersuchungen über den Geotropismus der Rhizoiden. Beih. Bot. Centralbl. **28:** 94–133. 1912.

[7] JOST, L., and STOPPEL, R., Studien über Geotropismus. II. Die Veränderung der geotropischen Reaktion durch Schlenderkraft. Zeitsch. Bot. **4:** 207–229. 1912.

medium intensity of the stimulus produces no reaction; also the positive curving occurs in the zone of most rapid growth, while the negative takes place in the region of greater maturity. The *quantity of stimulus law* already established for heliotropism and geotropism[8] is confirmed by this work. The quantity of stimulus necessary for a negative response is about 1000 times that necessary for a positive response.

JOST[9] takes up the several positive arguments that have been offered in favor of the starch statolith theory, and with some partisanship shows their shortcomings. He observes that the negative argument is often used; that while many facts do not aid in substantiating the theory they at least do not disprove it. This statement holds, he asserts, because the theory itself has experienced a gradual process of adaption to the demands of newly established facts, which makes the theory of 1909 quite a different thing from that of 1900. In its earlier form the starch must actually fall on the *Plasmahaut* and lie there for some time to induce the reaction, while in the later form movement of the starch without geo-perception is explained by lack of irritability of the plasma, and geo-perception without movement of starch is explained by saying that actual displacement of the starch is not necessary for perception.

The author has studied the response of the root on the Piccard centrifuge and the effect of the removal or injury of various regions of the root tip on geo-perception and geo-response. The results on the Piccard centrifuge agree with those of HABERLANDT,[10] though the author gives them a different interpretation, which he believes accords better with all the facts known. Any injury that leaves the root tip attached or removes 0.5–0.75 mm. gives a wound effect that hinders geo-response for some hours. Removal of 1 mm. or more of the tip hinders geo-response for many days. JOST believes removal of 1 mm. or more of the tip affects the response in three ways: by wound shock, by removing a highly sensitive geo-perceptive region, by removing a region of great tonic significance in rendering other regions sensitive. His main evidence for the tonic effect of the tip 1 mm. is the fact that on the Piccard centrifuge the tip must extend over the point at least 1.5 mm. to give a reaction in favor of the tip, showing considerable sensitiveness in the growth zone; while removal of only 1 mm. of the tip renders the growth zone ineffective. The author believes that NĚMEC's conclusion that statolith starch is necessary in the tip for geo-perception lacks evidence, and that such a conclusion was drawn because NĚMEC failed to recognize the important tonic effect of the tip 1 mm. JOST believes that the meristem of the tip, along with the cap region immediately bordering on it on the one hand and the growth region on the other, are the regions of the maximum sensibility, while other regions may perceive but give

[8] See review of BLAAUW in BOT. GAZ. **49**: 238. 1910.

[9] JOST, L., Studien über Geotropismus. I. Die Verteilung der geotropischen Sensibilität in der Wurzelspitze. Zeitsch. Bot. **4**: 161–205. 1912.

[10] See review in BOT. GAZ. **47**: 482. 1912.

no results unless the tip is present. The meristem in *Lupinus*, the form used, is starch free, consequently this interpretation which seems to agree well with all facts observed is opposed to the starch statolith theory.—WILLIAM CROCKER.

Gummosis.—SORAUER,[11] in two extensive papers, discusses gum-flow in the cherry and related phenomena in some other trees. He concludes that the tendency to gummy degeneration is latent in the cherry tree, and that stimuli such as frost and wounds only accentuate a natural tendency. Individual cells in the pith and bast, which in perfectly normal twigs of various trees show swelling of the walls and discoloration and degeneration of the contents, exhibit the primary evidences of the tendency to gummosis. Through variations in growth that may be regarded as normal, such as unusual breadth of the medullary rays, or through variations in nutrition affecting turgor, or through wounds, effects of frost, etc., the tension relations between pith and wood, and between wood and bark, are frequently greatly altered, resulting in release of pressure at certain points. At these points, islands of parenchymatic cells are regularly formed, among and in place of the normal prosenchymatic cells. This is a common phenomenon in many trees, without gummosis following; but in the cherry such islands of cells are the usual foci of gummy degeneration. They are particularly numerous in the wood formed by late fall growth; consequently different parts of the same branch or tree vary enormously in the tendency to gummosis.

Cells having the tendency to gummosis are deficient in starch, thin-walled, with heavy deposits of tannin and phloroglucin; in a word, they are cells which fail to mature. The cause of degeneration may be regarded as an excess of enzymes; degeneration in the individual cell starts in the cell contents, and extends to the secondary membrane, which swells and furnishes the chief material for the gum. As the gummosis extends to adjacent cells the order is of course reversed, the intercellular substance being first attacked, the cell contents last.

The bulk of these papers is devoted to a minute description of the histology and microchemical reactions of a great quantity of material illustrating various aspects of the gummosis problem. In addition to various species and varieties of *Prunus*, the following species are studied: *Corylus avellana*, *Pinus Laricio*, *P. silvestris*, *Fagus silvatica*, *Fraxinus excelsior*, *F. Ornus*, *Syringa vulgaris*, *Cytisus Laburnum*, *Tilia* sp., *Ampelopsis* sp., *Platanus* sp., and the pear. Scant attention is given to the work of previous investigators. These papers are of great value for the abundance of detailed observations, but the logic of the deductions is at times difficult to follow.

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[11] SORAUER, PAUL, Untersuchungen über Gummifluss und Frostwirkungen bei Kirschbäumen. Landwirtsch. Jahrb. **39**:259–297. *pls. 5.* 1910; and **41**:131–162. *pls. 2.* 1911.